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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/644,829	Applicant(s) SATOH, KIYOHIDE	
	Examiner Blake E. Betz	Art Unit 2672	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-27 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-27 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 1.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 6, 9, 14, 15, 17, 18, 24, 26, and 27 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,765,561 to Chen et al.

Chen et al. discloses the system and method as claimed in claims 1 and 24. Chen et al. describes a surgical targeting system that involves displaying an image created by intermixing a virtual image with a real image. Column 9, lines 38 – 43, describes aligning a real image taken from a video camera with a virtual image by holding the camera in a fixed position. "A first, and generally more preferable, technique involves holding the position of video camera 45 (and hence real image 55) constant and moving the position of the "virtual object" or the "virtual camera" by means of apparatus 57 until the virtual image 50 is brought into registration with real image 55." Column 11, lines 7 – 11, states, "More particularly, and looking now at FIG. 8, there is

shown a video camera 45, an anatomical structure 60, and a tracker system 65. Tracker system 65 comprises a tracker 70 which is attached to video camera 45, and a tracker base 75 which defines the coordinate system of the tracker system." Thus, Chen et al. teaches of an attitude sensor for measuring the attitude of the video camera. Lines 12 – 17 disclose matrix transformations from the patient to the camera, the camera to the tracker base, and the patient to the tracker base. Thus, calculation information is stored in the matrix transformations to calculate the attitude of the patient on the basis of an output from the tracker system. Column 6, lines 61 – 67, and column 7, lines 1 – 5, describe the use of an imaging machine to provide two-dimensional images of a patient's anatomical structure and storing the images in a patient-specific database. Column 8, lines 10 – 46, discloses the placement of virtual planning markers in the patient-specific images by a physician. Column 9, lines 43 – 47, describes a detecting algorithm to perform a template matching process between planning markers of a virtual image and a target image. "This can be done automatically by having image generator 30 use a search algorithm to match the virtual image to the real image, in which case apparatus 57 includes computer hardware and software of the sort well known in the art to cause image generator 30 to work through a search algorithm to match the virtual image to the real image." Column 12, lines 26 – 37, discloses detecting the position of an anatomical structure in a real image by performing a data matching procedure to correlate sampled points with patient-specific images. "It is also anticipated that one could use a tracked surgical instrument 85 to determine the location of anatomical structure 60. This can be accomplished by using the tracked surgical

instrument 85 to engage known fiducial points on the anatomical structure. Alternatively, a tracked surgical instrument 85 can be used to sample multiple surface points located on the anatomical structure and then use a data matching procedure to correlate the sampled points with either patient-specific database 10 or patient-specific 3-D computer model 15." Column 11, lines 18 – 29, describe an updating of the calculation information on the basis of a detected position of a marker in the patient image then calculating the attitude of the patient in relation to the tracker system on the basis of known values and the updated calculation information from the matrix transformations. "M.sub.CT is known from the tracker system. Furthermore, once the virtual image generated by image generator 30 has been placed in registration with the real image generated by camera 45, the virtual camera position will be known relative to the virtual anatomical structure, and hence the real camera position will be known relative to the real anatomical structure. Thus, real matrix M.sub.PC will also be known. In addition, since M.sub.CT and M.sub.PC are then both known, it is possible to solve for M.sub.PT. Accordingly, the position of anatomical structure 60 will then also be known within the relative coordinate system defined by the tracker system."

Chen et al. discloses the device of claims 6 and 9. Column 11, lines 12 – 29, discloses calculation information in the form of matrix transformations for calculating the position and attitude of the patient on the basis of the measured value and position information of the pick-up visual point of the camera in regard to the tracker system. "In this setting, M.sub.PC can be considered to represent the matrix transformation from the patient's anatomical structure 60 to camera 45; M.sub.CT can be considered to

represent the matrix transformation from camera 45 to tracker base 75; and M.sub.PT can be considered to represent the matrix transformation from anatomical structure 60 to tracker base 75.

M.sub.CT is known from the tracker system. Furthermore, once the virtual image generated by image generator 30 has been placed in registration with the real image generated by camera 45, the virtual camera position will be known relative to the virtual anatomical structure, and hence the real camera position will be known relative to the real anatomical structure. Thus, real matrix M.sub.PC will also be known. In addition, since M.sub.CT and M.sub.PC are then both known, it is possible to solve for M.sub.PT. Accordingly, the position of anatomical structure 60 will then also be known within the relative coordinate system defined by the tracker system." Therefore, the calculation information is updated once the virtual image is placed in registration with the real image generated by the camera and the matrix transformations are formed.

Chen et al. discloses the device of claims 14 and 15. Column 12, lines 26 – 35, describes using known fiducial points on the anatomical structure of a patient for tracking. "It is also anticipated that one could use a tracked surgical instrument 85 to determine the location of anatomical structure 60. This can be accomplished by using the tracked surgical instrument 85 to engage known fiducial points on the anatomical structure. Alternatively, a tracked surgical instrument 85 can be used to sample multiple surface points located on the anatomical structure and then use a data matching procedure to correlate the sampled points with either patient-specific database 10 or

patient-specific 3-D computer model 15." Thus, the patient in the video camera image may have known fiducial points located on their anatomical structure in real space.

Chen et al. discloses the device of claims 17 and 18. Column 10, lines 1 – 15, states, "Once virtual image 50 has been placed into proper registration with real image 55, image generator 30, video camera 45 and video mixing device 35 can be used to present the virtual and real images on display 40 in various presentation formats so as to facilitate a particular medical procedure. In particular, one can use image generator 30, video camera 45 and video mixing device 35 to superimpose a virtual image (generated from patient-specific 3-D computer model 15) against a real image (generated by video camera 45), with image generator 30 being directed to modify the virtual image so as to expose one or more of the virtual planning markers 25 present in patient-specific 3-D computer model 15, whereby the anatomy highlighted by virtual planning markers 25 will be brought quickly to the attention of the physician." Thus, real image is a visual point of the visual camera. Additionally, column 9, lines 43 – 49, notes a search algorithm to match the virtual and real images. "This can be done automatically by having image generator 30 use a search algorithm to match the virtual image to the real image, in which case apparatus 57 includes computer hardware and software of the sort well known in the art to cause image generator 30 to work through a search algorithm to match the virtual image to the real image."

Chen et al. discloses the program code of claim 26 and the storage medium of claim 27. Figure 10 shows an overall flow diagram of the invention of Chen. A program module is shown that runs an algorithm to align the real and virtual images. Thus, the

algorithm to be run is interpreted as program code for executing the image processing method. Column 9, lines 38 – 49, describes the use of the algorithm including computer hardware and software such that the program code is stored on the hardware medium.

Claims 2, 19, 20, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,765,561 to Chen et al. in view of U.S. Patent No. 5,531,227 to Schneider.

Chen et al. discloses the device of claim 2 except wherein said target image setting unit obtains a predicted position of the index in the picked-up image employing said measured value and said calculation information stored in said storage unit and creates an image with a peripheral area around said prediction position in said picked-up image subjected to a rotational process on the basis of a rotational angle in a roll direction of said image pick-up device derived from said measured value. The invention of Schneider teaches of obtaining images in a pre-procedural time and segmenting them into sub-objects that have defined boundaries, shapes, and positions within the overall image. Column 8, lines 36 – 52, describes segmenting the images while they are digitally analyzed to identify predefined fiducial markers by means of feature extraction, edge detection, region growing, boundary analysis, template matching, etc. Column 9, lines 4 – 10, states, "Particularly likely to be useful in the future are those statistical segmentation techniques that assign to each point a certain degree of probability as to whether or not it is a part of a given segmented object. That probability is based upon a variety of factors including pixel intensity and location with respect to other pixels of given qualities. Once probabilities of each pixel have been determined,

assessments can be made of the pixels as a group, and segmentation can be achieved with improved accuracy." Additionally, column 10, lines 4 – 15, teaches of rotating captured images so as to align the images, according to the fiducial markers, to a corresponding position orientation. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include segmenting the captured virtual images so as to include a peripheral area around a predicted position of the index. One would have been motivated to make such a modification to the invention of Chen so that upon performing template matching between virtual and real images, the speed of identifying marker matches is increased by bounding a search area within a smaller particular region of the overall image. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen to include subjecting the captured images to rotational process. One would have been motivated to make such a modification to the invention of Chen so that while performing template matching between a virtual and a real image, the orientations of the images may be aligned so as to properly line up their fiducial markers.

Chen et al. discloses the device of claim 19 except wherein the measurement object is a visual point of the observer, and optically transmitting the image in the real space through the display screen observed by the observer while displaying the image in the virtual space on the display screen. Column 7, lines 20 – 25 of Schneider, states, "A lead imager 18 is provided to obtain an image of object 10 along a chosen perspective or line of view. For example, if object 10 is a patient in an operating room,

lead imager 10 may be a video camera that obtains video images of the patient along the line of sight of the attending physician, such as a head-mounted video camera." Thus, the measurement object in Schneider is a visual point of the observer. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen so that the measurement object is a visual point of the observer. During a medical procedure, it is important that a doctor quickly and easily obtains the orientation of planning markers on a patient with their perspective view of the patient. Thus, one would have been motivated to make such a modification to the invention of Chen so that during a medical procedure, the displayed view of a patient in a medical procedure would be oriented with the view of the doctor. Column 9, lines 38 – 49 of Chen, describes aligning a virtual image with a real image on the basis of the position of both images and the video camera so as to display the images simultaneously on a display screen. Column 10, lines 44 – 47 of Schneider, teaches of displaying a virtual image while optically transmitting a real image through the display. "Additionally, the transformed and sliced follow image can be projected onto a see-through display mounted in front of the physician's eyes so that it is effectively combined with the physician's direct view of the patient." Chen et al. teaches in column 10, lines 59 – 63, that to perform image correspondence between a captured image and a virtual image requires a substantial amount of time, even with high speed hardware. Additionally, it is well known in the art that displaying an image on a graphics display requires an amount of hardware utilization. Thus, not displaying a real image by allowing the image to pass through a display and displaying a virtual image in alignment

with the real image will require less processing than if both images needed to be generated. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen to optically transmit a real image through a display screen while displaying a virtual image in alignment with the real image as in Schneider. One would have been motivated to make such a modification to Chen so that less time would be required to generate the display by the hardware in the system.

Chen et al. discloses the device of claims 20 and 21, see description according to claim 1, except wherein a target image is created having a peripheral area around a predicted position in a picked-up image subjected to a rotational process on the basis of a rotational angle in a roll direction of said image pick-up device derived from said measured value. Chen et al. teaches in column 11, lines 3 – 11, of a tracker system attacked to a video camera such that the position of the camera will be predetermined by the tracker system. Schneider teaches of obtaining images in a pre-procedural time and segmenting them into sub-objects that have defined boundaries, shapes, and positions within the overall image. Column 8, lines 36 – 52, describes segmenting the images while they are digitally analyzed to identify predefined fiducial markers by means of feature extraction, edge detection, region growing, boundary analysis, template matching, etc. Column 9, lines 4 – 10, states, "Particularly likely to be useful in the future are those statistical segmentation techniques that assign to each point a certain degree of probability as to whether or not it is a part of a given segmented object. That probability is based upon a variety of factors including pixel intensity and

location with respect to other pixels of given qualities. Once probabilities of each pixel have been determined, assessments can be made of the pixels as a group, and segmentation can be achieved with improved accuracy." Additionally, column 10, lines 4 – 15, teaches of rotating captured images so as to align the images, according to the fiducial markers, to a corresponding position orientation. Thus, the position of the area to be segmented is determined by a statistical segmentation technique while the video camera is at a predetermined position. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include segmenting the captured virtual images so as to include a peripheral area around a predicted position of the index. One would have been motivated to make such a modification to the invention of Chen so that upon performing template matching between virtual and real images, the speed of identifying marker matches is increased by bounding a search area within a smaller particular region of the overall image. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen to include subjecting the captured images to rotational process. One would have been motivated to make such a modification to the invention of Chen so that while performing template matching between a virtual and a real image, the orientations of the images may be aligned so as to properly line up their fiducial markers.

Claims 3, 10, 11, and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,765,561 to Chen et al. in view of U.S. Patent No.

5,531,227 to Schneider as applied to claim 2 and further in view of U.S. Patent No. 6,369,953 to Rallison et al.

Chen and Schneider disclose the device of claim 3 except wherein said calculation information is the correction information to correct for an error in the measured value of attitude measured by said attitude sensor of the image pick-up visual point of said image pick-up device, and said calculation unit calculates attitude of said measurement object on the basis of the measured value and correction information. The invention of Rallison et al. teaches of tracking the position and attitude of an image generator mounted on the head of a person. Column 19, lines 11 – 26, teaches of the various types of tracker systems including magnetic and inertial sensor systems. Columns 21, 22, and 23 explain obtaining position and attitude orientation with the two systems. Column 24, lines 37 – 67, and column 25, lines 23 – 62, describe correcting for an error in the measured values of attitude and position taken from the sensor systems. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include using an inertial sensor system as the tracker system for the video camera. One would have been motivated to make such a modification to Chen since inertial sensors such as rate gyros will have the advantage of being substantially immune to magnetic perturbations that may be present in a medical operating atmosphere. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to correct for an error in the measured value of attitude information of the inertial sensors for use in the matrix transformation calculations of Chen. One would have been motivated to

make such a modification to the invention of Chen so that the calculated position and attitude information of the camera and patient remain accurate while performing a medical procedure.

Chen et al. discloses the device of claims 10, 11, and 12. Column 11, lines 12 – 29, discloses calculation information in the form of matrix transformations for calculating the position and attitude of the patient on the basis of the measured value and position information of the pick-up visual point of the camera in regard to the tracker system. "In this setting, M.sub.PC can be considered to represent the matrix transformation from the patient's anatomical structure 60 to camera 45; M.sub.CT can be considered to represent the matrix transformation from camera 45 to tracker base 75; and M.sub.PT can be considered to represent the matrix transformation from anatomical structure 60 to tracker base 75.

M.sub.CT is known from the tracker system. Furthermore, once the virtual image generated by image generator 30 has been placed in registration with the real image generated by camera 45, the virtual camera position will be known relative to the virtual anatomical structure, and hence the real camera position will be known relative to the real anatomical structure. Thus, real matrix M.sub.PC will also be known. In addition, since M.sub.CT and M.sub.PC are then both known, it is possible to solve for M.sub.PT. Accordingly, the position of anatomical structure 60 will then also be known within the relative coordinate system defined by the tracker system." Therefore, the calculation information is updated once the virtual image is placed in registration with the real image generated by the camera and the matrix transformations are formed.

Additionally, column 12, lines 35 – 37, describes using a least squares fit to correlate the sampled points with the patient-specific images. Thus, a typical value is used that incorporates a dislocation value between the predicted position and the detected position of a plurality of markers from a real and virtual image.

Claims 4, 5, 7, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,765,561 to Chen et al. in view of U.S. Patent No. 6,369,952 to Rallison et al.

Chen et al. discloses the invention of claims 4 and 5 except wherein said calculation information is the correction information to correct for an error in the measured value of attitude measured by said attitude sensor and the position information of the image pick-up visual point of said image pick-up device, and said calculation unit calculates the position and attitude of said measurement object on the basis of the measured value, correction information, and the position information. The invention of Rallison et al. teaches of tracking the position and attitude of an image generator mounted on the head of a person. Column 19, lines 11 – 26, teaches of the various types of tracker systems including magnetic and inertial sensor systems. Columns 21, 22, and 23 explain obtaining position orientation with the two systems. Column 24, lines 37 – 67, and column 25, lines 23 – 62, describe correcting for an error in the measured values of attitude and position taken from the sensor systems. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include using an inertial sensor system as the tracker system for the video camera. One would have been motivated to make such

a modification to Chen since inertial sensors such as rate gyros will have the advantage of being substantially immune to magnetic perturbations that may be present in a medical operating atmosphere. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to correct for an error in the measured value of attitude and position information of the inertial sensors for use in the matrix transformation calculations of Chen. One would have been motivated to make such a modification to the invention of Chen so that the calculated position and attitude information of the camera and patient remain accurate while performing a medical procedure.

Chen and Rallison teach of the device of claim 7. Chen in view of Rallison teaches of updating the position information with regard to a series of matrix transformations in column 11, lines 7 – 30. Additionally, column 9, lines 38 – 49, describe a search algorithm for automatically bringing a virtual image into registration with a real image. Column 10, lines 38 – 52, describes reestablishing the registration between a real image and a virtual image if the video camera position is moved. Thus, Chen and Rallison teach of updating position information. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen and Rallison so that the position information is only updated in two directions and not in a depth direction if the action is so desired by a user while reestablishing a registration between a real image and a virtual image. One would have been motivated to make such a modification to the invention of Chen and Rallison so

that if an updated value in a depth direction is not required by a user, the computing system does not waste utilization time and resources calculating an unnecessary value.

Chen and Rallison teach of the device of claim 16. Column 8, lines 10 – 30 of Chen, describes the index and virtual markers as being image features of interest to the physician in the patient-specific images. "More particularly, apparatus 20 preferably comprises computer hardware and software adapted to allow a physician to access one or more of the patient-specific 2-D images contained in patient-specific database 10 and present them for viewing, in the manner shown in FIG. 2. Then, using a mouse or other data entry device, the physician can place one or more virtual planning markers 25 into an accessed patient-specific 2-D image, in the manner shown in FIG. 3. These virtual planning markers 25 can consist of substantially any geometric form such as a point, a line, a circle, a plane, a path (either straight or curved), etc., and are positioned about anatomical structures of particular interest to the physician."

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,765,561 to Chen et al. in view of U.S. Patent No. 6,369,952 to Rallison et al. as applied to claim 3 and further in view of Fixsen et al.

Chen and Rallison disclose the device of claim 8 except wherein the correction information is the information to correct for an error in the azimuth direction among the measured values of the attitude measured by the attitude sensor. In column 23, lines 60 – 67, and column 24, lines 1 – 23, Rallison additionally teaches of sensor drift, thus causing an error in the measured values of roll, pitch, and yaw. Page 20, table 2 of Fixsen et al., and page 25, first paragraph, teaches of the interchangeability of the terms

yaw and azimuth in position measurements. Thus, it is inherent that the use of a gyroscopic tracking system in the invention of Chen in view of Rallison will accumulate an error in the measured directions, including the azimuth measurements. Therefore, the use of the yaw correction information in the matrix transformations in the invention of Chen in view of Rallison is equivalent to the use of the azimuth correction information.

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,765,561 to Chen et al. in view of U.S. Patent No. 6,369,952 to Rallison et al. as applied to claim 5 and further in view of U.S. Patent No. 5,531,227 to Schneider.

Chen and Rallison teach of the device of claim 13 except wherein the updating unit updates the position information in three directions in the camera coordinate system of the video camera when two or more indices are detected in the detecting unit. Schneider teaches of determining the orientation, two-dimensional information, and size, three-dimensional information, regarding a captured and stored image via triangulation with multiple fiducial markers. Column 11, lines 63 – 67, and column 12, lines 1 – 2, state, "For example, instead of determining the orientation of the object by determining the orientation of a single fiducial marker, as in the preferred embodiment, orientation and size information regarding the lead and follow images can be determined via triangulation by determining the relative position of the multiple fiducial markers as seen from a particular line of view." It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Chen and Rallison to include updating the position information with regard to the matrix

transformations in three directions in the camera coordinate system when two or more indices are detected via triangulation as in Schneider. One would have been motivated to make such a modification to the invention of Chen and Rallison so that the position information as determined by the matrix transformations of Chen will provide the spatial relationship of an anatomical structure within the relative coordinate system defined by the tracker system.

Claims 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,765,561 to Chen et al. in view of U.S. Patent No. 6,369,952 to Rallison et al. and Fixsen et al.

Chen et al. discloses the device of claims 22 and 23 except wherein the attitude sensor is constituted of a gyro sensor and the attitude sensor measures the attitude of an image pick-up point of the video camera in a state where there is an accumulated error in the measured value in the azimuth direction. Column 11, lines 7 – 11, describes a tracker system attached to the video camera in the invention. Column 19, lines 11 – 26 of Rallison, teaches of the various types of tracker systems including magnetic and inertial sensor systems. Column 20, lines 57 – 63, describes the use of a rate gyro in an inertial sensing system. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include using an inertial sensor system as the tracker system for the video camera. One would have been motivated to make such a modification to Chen since inertial sensors such as rate gyros will have the advantage of being substantially immune to magnetic perturbations, as stated in column 23, lines 37 – 40, that may be present in a

medical operating atmosphere. In column 23, lines 60 – 67, and column 24, lines 1 – 23, Rallison additionally teaches of sensor drift, thus causing an error in the measured values of roll, pitch, and yaw. Page 20, table 2 of Fixsen et al., and page 25, first paragraph, teaches of the interchangeability of the terms yaw and azimuth in position measurements. Thus, it is inherent that the use of a gyroscopic tracking system in the invention of Chen in view of Rallison will accumulate an error in the measured directions, including the azimuth measurements.

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,765,561 to Chen et al. in view of U.S. Patent No. 6,369,952 to Rallison et al. and Fixsen et al. as applied to claim 23 and further in view of U.S. Patent No. 5,531,227 to Schneider.

Chen, Rallison, and Fixsen teach of the method of claim 25 except wherein a target image is created having a peripheral area around a predicted position in a picked-up image subjected to a rotational process on the basis of a rotational angle in a roll direction of said image pick-up device derived from said measured value. Chen et al. teaches in column 11, lines 3 – 11, of a tracker system attacked to a video camera such that the position of the camera will be predetermined by the tracker system. Schneider teaches of obtaining images in a pre-procedural time and segmenting them into sub-objects that have defined boundaries, shapes, and positions within the overall image. Column 8, lines 36 – 52, describes segmenting the images while they are digitally analyzed to identify predefined fiducial markers by means of feature extraction, edge detection, region growing, boundary analysis, template matching, etc. Column 9, lines 4

– 10, states, "Particularly likely to be useful in the future are those statistical segmentation techniques that assign to each point a certain degree of probability as to whether or not it is a part of a given segmented object. That probability is based upon a variety of factors including pixel intensity and location with respect to other pixels of given qualities. Once probabilities of each pixel have been determined, assessments can be made of the pixels as a group, and segmentation can be achieved with improved accuracy." Additionally, column 10, lines 4 – 15, teaches of rotating captured images so as to align the images, according to the fiducial markers, to a corresponding position orientation. Thus, the position of the area to be segmented is determined by a statistical segmentation technique while the video camera is at a predetermined position. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen et al. to include segmenting the captured virtual images so as to include a peripheral area around a predicted position of the index. One would have been motivated to make such a modification to the invention of Chen so that upon performing template matching between virtual and real images, the speed of identifying marker matches is increased by bounding a search area within a smaller particular region of the overall image. It would have been further obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Chen to include subjecting the captured images to rotational process. One would have been motivated to make such a modification to the invention of Chen so that while performing template matching between a virtual and a real image, the orientations of the images may be aligned so as to properly line up their fiducial markers.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

U.S. Patent No. 5,274,551 to Corby, Jr.

U.S. Patent No. 5,291,889 to Kenet et al.

U.S. Patent No. 5,596,365 to Erickson et al.

U.S. Patent No. 5,926,568 to Chaney et al.

U.S. Patent No. 5,999,840 to Grimson et al.

U.S. Patent No. 6,064,398 to Ellenby et al.

U.S. Patent No. 6,166,744 to Jaszlics et al.

U.S. Patent No. 6,347,240 to Foley et al.

U.S. Patent No. 6,701,174 to Krause et al.

U.S. PG-PUB No. 20010048763 to Takatsuka et al.

U.S. PG-PUB No. 20020084974 to Oshima et al.

Tripathi, "AUGMENTED REALITY : AN APPLICATION FOR ARCHITECTURE" http://www.usc.edu/dept/architecture/mbs/thesis/anish/thesis_report.htm

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Blake E. Betz whose telephone number is (703) 605-4584. The examiner can normally be reached on 7:30 - 4:00 M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Razavi can be reached on (703) 305-4713. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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